The Role of Screening and Cross-Selling in Bank-Firm Relationships

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Abstract

This paper presents a monopolistic competition model of a bank choosing the optimal level of the screening effort in the presence of cross-selling activities. We demonstrate that, under general assumptions, the larger is the range of services that the bank produces, the lower is the optimal screening effort. This result can be reversed if we assume that the probability of selling services other than loans depends on the screening effort and/or that the marginal cost of screening decreases with the range of services provided by the bank. The paper also analyses the impact of competition in the lending market on the screening and cross-selling activities.

Keywords: bank-firm relationships, screening, cross-selling, financial services

JEL Codes: G21, L15, D83

1 Introduction

In Europe commercial banks are changing with the rapid change in financial services. Banks are no more only lending institutions but they are becoming complex organisations involved more and more in the provision of a set of related services, such as trusts, annuities, mutual funds, mortgage banking, insurance brokerage and transaction services. The traditional role of banks as producers of imperfect information about borrowers is challenged in the changing environment. Will the relationship-oriented European banking system survive?

According to Allen and Santomero (2001), banks have managed to develop new lines of business to compensate for the decline in the traditional intermediation business both in Europe and in the United States. Furthermore in the financial sector having customer information available for multiple uses, using
distribution channels established for one sector to sell other products, using a
good reputation of one firm, i.e. a bank, to enhance the sale of other products
may significantly reduce average costs (Herring and Santomero, 1990). Even if
the progressive transition to a marketing orientation in banking had been recog-
nised since the Seventies, it is in the last decade that a growing number of banks
have started to implement cross-sell programs across their branch network in
an effort to become sales driven organisations.

While there is empirical evidence of a transition to a marketing orientation
in banking, we are not aware of any theoretical model investigating its impact
on the traditional role of banks as providers of screening services. The first aim
of this paper is to fill this gap by proposing a spatial imperfect competition
model of the banking sector where the bank provides loans to loan applicants
after a costly screening process. Each bank may get some information on which
of the projects is expected to fail by using a creditworthiness test that we model
following Devinney (1986) and Gehrig (1998). We assume that positively eval-
uated applicants are more likely to buy other services from their lending bank
and we study how the bank cross-selling activity affects its screening incentives.
We show that, in the absence of information synergies between the cross-selling
and the screening activities, cross-selling has a negative impact on the optimal
screening effort while this result can be reversed when information synergies are
sufficiently big.

We define “cross-selling” as a bundling strategy based on the assumption
that, once a loan applicant gets a loan, he becomes a warm customer, i.e. it
becomes easier to sell to that customer other services different from loans. In
the standard industrial organisation literature bundling can serve as a price
discrimination device either in a “pure bundling” strategy, when the firm sells
two or more goods only in package, or in a “mixed bundling” strategy, when
the firm sells the same goods separately as well as packaged (Adams and Yellen,
1976; McAfee, Mc Millan and Whinston, 1989). In the model of Chiappori,
Perez-Castrillo and Verdier (1995) “pure bundling” between loans and deposits
is not a price discrimination device but an optimal strategy to get around the
regulation. In our model we have neither a “pure bundling” strategy, since when
the bank sells a loan to a customer he is not obliged to buy other services, nor
a true “mixed bundling” strategy since all the loans are packaged with other
services that will be bought by the customer with a positive probability. The
relationship with a borrower has a marketing value for the bank and the bank
must consider the cost of rejecting loan applicants when choosing the optimal
level of the screening effort.

The effect of cross selling on screening incentives is obviously affected by the
existence of relevant information synergies between the different activities per-
formed by the bank. There is a large literature analysing information synergies
between loans and deposits. Nakamura (1993) argues that the joint provision
of loans and deposits makes bank lending special by allowing the bank to learn
from deposits about its borrowers. Mester, Nakamura and Renault (2002) pro-
vide detailed evidence of how a commercial bank uses information about current
accounts to determine its credit ratings of borrowers and adjust the intensity of
its monitoring activity. This literature demonstrates that selling services different from loans may decrease substantially bank’s screening costs. In our model the existence of a sort of “information reusability”, like in the model of Millon and Thakor (1985) where the bank by gathering information about one project gets indirectly information about similar projects, may give rise to relevant information synergies between the provision of loans and that of other services. On the one hand, information about the services bought by a customer may lower banks’ screening costs. On the other hand, information collected about a potential borrower may be used to increase the probability of selling him services other than loans.

The second aim of this article is to study the effect of a more competitive environment on the profitability of cross-selling. May cross-selling be a response to the increasing competition in the European lending market caused by the progressive capital market liberalisation?

According to our model the expected profitability of services increases with the proportion of positively evaluated borrowers and decreases with the equilibrium number of firms (since each firm has a lower market share). An increase in competition (a decrease in transportation costs) leads to a lower optimal lending rate and to less entry. Moreover it affects the optimal screening effort and, therefore, the proportion of positively evaluated borrowers. We show that, for sufficiently low levels of transportation costs, an increase in competition in the lending market increases the expected profitability of services thus creating an incentive for banks to engage in cross-selling activities.

In the literature on relationship lending we find several papers investigating about the possibility that more competition in the lending market might hinder relationship lending. A recent literature (Caminal and Matutes, 2002; Freixas, 2005) analyses how competition in credit market may lower the optimal monitoring effort. Since the “interim monitoring” effort (the effort that allows the bank to prevent the firm from investing in inefficient projects) increases with the expected excess return on banks’ investment, more competition in the banking industry decreases the monitoring effort. Bank monitoring generates soft information that allows parties to implement more efficient outcomes. From an ex-ante perspective Gehrig (1998) and Dell’Ariccia (2000) in different types of models show that the relationship between competition and screening is ambiguous. Boot and Thakor (2000) and Yafeh and Yosha (2001) demonstrate that when competition increases, the profitability of market finance decreases more than that of relationship loans so the bank is induced to increase “relationship” lending and to decrease “transaction” lending.

In this paper the direct impact of competition on screening depends on the expected profitability of good and bad projects (as in Gehrig, 1998), but we also suggest another possible indirect effect of competition on relationship lending: in our model higher competition may cause an increase of cross-selling profitability and higher cross-selling may reduce the bank’s optimal screening effort.

The paper is organised as follows. Section 2 presents the basic set-up of the model. Section 3 analyses the impact of cross-selling on screening. Section 4 focuses on the effect of competition in the lending market on cross-selling.
Section 5 analyses the empirical implications of the model and the last section draws the main conclusions of the paper.

2 The theoretical model

We analyse a spatial competition model of the banking sector where banks have the possibility to sell to their customers other services different from loans. In what follows we will present the basic set-up of the model describing the assumptions on the borrower’s behaviour, the bank’s behaviour, the screening activity, and the cross-selling activity.

Borrowers

We use a Salop model of spatial competition (Salop, 1979) so we consider an economy with a continuum of potential risk neutral borrowers located uniformly (with density 1) around a unit circle, each having an investment project to be financed with 1 unit of loanable funds that they can borrow from a bank. Each borrower has a transportation cost $\gamma > 0$ for unit of length. The project generates a random return $y$. There are two types of projects, good and bad. A good project generates a random return $y_h(z)$, which is characterised by a random binary variable $y_h(z) \in \{0, z\}$ and the positive outcome $z$ occurs with probability $p_h$; a bad project generates a random return $y_l(z)$, $y_l(z) \in \{0, z\}$, and the positive outcome $z$ occurs with probability $p_l < p_h$.

The proportion of good projects (for which $z \cdot p_h > r_f$, where $r_f$ is the risk-free interest factor) in the population is $\theta \in [0, 1]$ and is common knowledge. Good borrowers are observationally indistinguishable from bad ones without some screening activity.

In the population bad borrowers have a mean expected rate of return less than the cost of loanable funds, so that $z \cdot p_l < r_f$ (i.e. bad projects are dominated by the safe capital market investment). We assume that, for each borrower (good and bad), the surplus generated by the loan in case of success is ‘large enough’ so that he will borrow at the prevailing rate (since borrowers are protected by limited liability, entrepreneurs always apply for loans as long as the net outcome in case of success is larger than the transportation cost). Banks need to screen loan applicants in order to reject bad projects.

Banks

There are $n$ banks located around the unit circle and market power derives from transportation and location costs. Each bank has a fixed cost of installation $K$. Banks are risk neutral and maximise their expected profits. They have access to competitive capital markets, where they issue bonds at the risk free interest factor $r_f$.

Each bank may get some information on which of the projects is expected to fail by using a creditworthiness test that we model following Devinney (1986) and Gehrig (1998). Each bank must decide the optimal screening effort and the loan interest rate. Banks sell also services other than loans to loan applicants.

The screening activity
Each bank’s screening activity can be described in terms of a creditworthiness test. Only borrowers that pass the test get the loan. The bank observes noisy signals of the borrowers quality, good or bad, and the signal characteristics correspond to the pool characteristics. The test imperfectly assigns firms to one of the two risk classes, respectively good and bad borrowers.

If $e$ is the effort of the bank in the screening activity, we may define $\alpha(e) = \text{prob}(\text{accept/good})$ as the probability of accepting a truly good project; $1 - \alpha(e)$ as the probability of a type I error of the test (rejecting a good borrower); $\beta(e) = \text{prob}(\text{accept/bad})$ as the probability of a type II error of the test (erroneously accepting a bad borrower); $1 - \beta(e) = \text{prob}(\text{reject/bad})$ as the probability of rejecting a truly bad project (see table 1).

The higher is the per applicant effort $e \in [0, 1]$ in the screening activity, the higher is the ability of the bank to recognise good projects with $\alpha'(e) \geq 0$, $\beta'(e) \leq 0$, $\alpha''(e) \leq 0$, $\beta''(e) \geq 0$. We assume, as in Gehrig (1998), that screening at intensity zero is completely uninformative. Therefore, since the probability of observing a good signal is $\theta$ and the probability of observing a bad signal is $(1 - \theta)$, then $\alpha(0) = \theta$ and $\beta(0) = 1 - \theta$. At intensity 1 the screening technology is completely informative and therefore: $\alpha(1) = 1$ and $\beta(1) = 0$.

Since screening is costly the bank must choose the optimal level of effort given the screening cost $C(e)$ that we assume to be strictly convex with $C''(e) > 0$, $C''(0) > 0$, $C(0) = 0$, and $\lim_{e \to 1} C'(e) = \infty$. This last assumption implies that $e = 1$ will never be optimal for the bank.

Table 1 The creditworthiness test

<table>
<thead>
<tr>
<th>EVALUATION/REALITY</th>
<th>Good</th>
<th>Bad</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Correct $\text{Prob} = \alpha(e)$</td>
<td>False positive $\text{Prob} = \beta(e)$ (type II error)</td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad</td>
<td>False negative $\text{Prob} = 1 - \alpha(e)$ (type I error)</td>
<td>Correct $\text{Prob} = 1 - \beta(e)$</td>
</tr>
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We define $A(e) = [\alpha(e)\theta + \beta(e)(1 - \theta)]$ as the selection ratio (i.e. the percentage of loan applicants that is positively evaluated by the bank). We will see that the properties of this ratio are important for understanding the way in which cross-selling affects credit availability and the optimal screening effort. In particular we will be interested in the effect of an increase in the screening effort on the selection ratio (the sign of $A'(e)$). This will depend on the proportion of good and bad projects and on the properties of the screening technology. We can define a bad state of the world that in which the percentage of bad projects in the population is larger than the percentage of good ones ($\theta < \frac{1}{2}$). In a bad state of the world and in the presence of a symmetric screening technology ($\alpha'(e) = -\beta'(e)$) we have $A'(e) < 0$, i.e. more screening reduces the percentage of projects that are positively evaluated by the bank. Without assuming a
symmetric screening technology, we can define a *prudent* bank as a bank whose screening technology is more efficient in rejecting bad borrowers than in accepting good ones ($\alpha'(e) < -\beta'(e)$). Since banks know the proportion of good and bad borrowers in the population it is more likely that they will be prudent in bad periods; if this is the case we have $A'(e) < 0$ in bad periods also without assuming a symmetric screening technology.

*The cross-selling activity*

Each bank is a multiproduct firm selling loans and other services. It pays fixed and variable costs for providing a number of different services $S$ other than loans. If the variable cost of providing an additional service is very small, we may consider only the fixed cost of implementing the service activity that is included in the banks’ installation cost $K(S)$ with $K'(S) > 0$. Firms that are not financed by banks, i.e. firms borrowing from the capital market, buy services from other suppliers. The banking system competes with other institutions (like insurance companies, investment companies and so on) in the market for services. Since there are many specialised institutions selling services, we assume that the bank is price taker in the service market and we denote the price of the service with $v_s$. We assume that the probability to sell a service to a customer, $p_s$, is larger than the probability of selling a service to a non-customer which, for simplicity, we normalise to zero. The expected revenue from selling services for the bank from every identical borrower is therefore equal to $p_s v_s S$. We also assume that the revenue from services is not state dependent (the borrower pays for services also in case of default out of the loan. Since we are interested in studying the interaction between screening and cross-selling we assume that the expected revenue from services is small enough that $p_l z + v_s p_s S < r_f$. This assumption ensures that for the bank the expected revenue from cross-selling is never sufficient to cover the losses on bad borrowers.

We can expect that different services have a different information content. In particular they can provide some information on the characteristics of the customers, thus lowering the cost of the screening activity. Depending on the information content of the services we can assume that total and marginal screening costs are decreasing with $S$. This means that, as a bank provides more services it gets some information on the characteristics of the customers. This information lowers the cost of screening and makes the screening activity more efficient.

At the same time, the screening activity can provide information that can be more or less valuable for the cross-selling activity, depending, inter alia, on the type of services the bank wants to sell. We can therefore assume that the probability of selling a service increases with the screening effort.
3 The impact of cross-selling on the optimal screening effort

In what follows we will first present the impact of services on the optimal level of screening under the assumption that the screening activity is non-informative for the cross-selling activity and that the cost of screening is not affected by the cross-selling activity (no interdependence). Under these assumptions we consider the impact of cross-selling on the optimal level of screening.

3.1 The impact of cross-selling on the optimal screening effort with no interdependence

Assume that \( n \) banks located symmetrically around a circle have entered the market. If \( r_i \) is the interest rate offered to borrowers by a typical bank and \( r_0 \) is the interest rate offered by its neighbour competitors (the banks \( i+1 \) and \( i-1 \)), a borrower located at distance \( x \in \left[0, 1/n\right] \) from the bank \( i \) will be indifferent between bank \( i \) and bank \( i+1 \) if:

\[
p_{h,i}(z-r_i) - \gamma x = p_{h,i}(z-r_0) - \gamma \left( \frac{1}{n} - x \right)
\]

where \( p_{h,i} \) is \( p_h \) for a good borrower and \( p_l \) for a bad borrower. Since in the population there are \( \theta \) good borrowers and \( 1- \theta \) bad borrowers, the demand function faced by each bank \( (2x) \) will be given by

\[
\frac{1}{n} - (r_i - r_0) \frac{p}{\gamma}
\]

where \( p = \theta p_h + (1 - \theta) p_l \). We first characterize the symmetric equilibrium and then analyse the impact of services on the optimal screening effort.

The optimal screening effort of the bank, and the optimal loan interest rate depend on the maximisation of the following expected profit function:

\[
\pi^e = \left[ \frac{1}{n} - \frac{p}{\gamma} (r_i - r_0) \right] [\alpha(e) \theta \eta_h + \beta(e) (1 - \theta) \eta_l - C(e)] - K(S) \quad (1)
\]

where \( \eta_h = p_h r - r_f + p_s v_s S \) is the net expected profit per good borrower and \( \eta_l = p_l r - r_f + p_s v_s S \) is the net expected profit per bad borrower.

Profits depend on both the lending and the cross-selling activities. In this first specification there is no exchange of information between the two activities, but borrowers that are positively evaluated become customers of the bank and this increases the probability of selling them other services.

Maximising (1) with respect to the screening effort and the interest rate we find the equilibrium values of the two endogenous variables.
Proposition 1 The optimal level of effort $e^*$ in the symmetric equilibrium (for $r_i = r_0$) satisfies:

$$\frac{1}{n} [\alpha'(e^*)\theta(p_h r^*(e^*) - r_f + p_s v_S) + \beta'(e^*)(1-\theta)(p_1 r^*(e^*) - r_f + p_s v_S) - C'(e^*)] = 0 \quad (2)$$

Proposition 2 The optimal lending rate $r^*$ in the symmetric equilibrium (for $r_i = r_0$) is given by:

$$r^* = \frac{\gamma}{p_m} + \frac{A(e^*)}{B(e^*)} (r_f - p_s v_S) + \frac{C(e^*)}{B(e^*)} \quad (3)$$

where $B(e^*) = [\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_i]$

What is the impact of cross-selling on the optimal screening effort? An increase in services has a direct impact on screening and an indirect impact through its impact on the optimal interest rate. By applying Cramer’s rule to the system of equations that implicitly define the optimal screening effort and the optimal interest rate (see Appendix A) we obtain:

$$\frac{de^*}{dS} = \frac{p_s v_S[A'(e^*)B(e^*) - B'(e^*)A(e^*)]}{-[A''(e^*)(p_s v_S - r_f) + B''(e^*)r^*- C''(e^*)][B(e^*) - (\gamma/p_m)|B'(e^*)|^2] = \frac{p_s v_S[\theta(1-\theta)(p_h - p_i)(\beta'(e^*)\alpha(e^*) - \alpha'(e^*)\beta(e^*))]}{-[\alpha''(e^*)\theta p_h + \beta''(e^*)(1-\theta)p_i - C''(e^*)][B(e^*) - (\gamma/p_m)|B'(e^*)|^2]} \quad (4)$$

The numerator in (4) is negative and the denominator is positive for the configuration of parameters that satisfy the second order conditions (see Appendix A). Therefore:

Corollary 1 Screening incentives are a decreasing function of the range of services ($S$) offered by the bank

What is the explanation of this result? More cross-selling increases the market value of borrowers and this induces banks to increase the selection ratio. The impact of services on the optimal screening effort via the selection ratio depends on the sign of $A'(e^*)$ (which is positive in good periods and negative in bad periods; see Section 2). At the same time an increase in $S$, for a given screening effort, leads to a decrease in the optimal lending rate (see from equation (3): $\partial r^*/\partial S = -[A(e^*)/B(e^*)]p_s v_S < 0$). This is because, with an increase in services, banks want to attract more borrowers in order to increase profits from the cross-selling activity. The change in the interest rate has an impact on the optimal screening effort whose sign depends on the sign of $B'(e)$. In particular the decrease in the optimal lending rate leads to a decrease in the optimal screening effort whenever the expected profitability of good projects increases more with the screening effort than the expected profitability from rejecting
risky projects, i.e. $\alpha'(e^*)\theta p_h > -\beta'(e^*)(1-\theta)p_l$; this is because whenever the benefits from identifying worthy projects exceeds the benefits from avoiding unworthy projects, the higher are lending margins the more banks are worried to lose good borrowers (since the marginal return on these borrowers increases) and therefore they increase the screening effort (see also Gehrig, 1998). What Corollary 1 shows is that in good periods (when $A'(e^*) > 0$ and, therefore, also $B'(e^*) > 0$) the negative impact of services on the optimal screening effort via the interest rate prevails over the positive impact via the selection ratio. On the other hand when $A'(e^*) < 0$ and $B'(e^*) < 0$ the negative impact of services on the optimal screening effort via the selection ratio prevails over the positive impact via the interest; finally when $A'(e^*) < 0$ and $B'(e^*) > 0$ both impacts are negative; therefore the total impact of an increase in services on the optimal screening effort is always negative.

Equation (4) also shows that the impact of services on the optimal screening effort depends on the level of competition (transportation costs). In particular:

**Corollary 2** For any given number of banks the impact of cross-selling on the optimal screening effort increases with a decrease in transportation costs.

Finally we can also analyse the impact of services on credit availability. In the symmetric equilibrium the total amount of loans financed by the banking system is $A(e^*)$ and the impact of services on credit availability is given by $A'(e^*) \cdot \left( \frac{dc}{ds} \right)$ therefore:

**Corollary 3** Services increase credit availability whenever $\alpha'(e^*) \theta < -\beta'(e^*)(1-\theta)$

This is more likely to happen in bad periods (when the proportion of bad projects is high). In this case the quality of the project pool financed by the bank worsens with the increase in services.

In the next section we will investigate how this result, that can cause some concern on the role of banks as producers of information about borrowers in the presence of cross-selling activities, is affected by the existence of some synergies between the screening and cross-selling activities.

### 3.2 The impact of cross-selling on the optimal screening effort in the case of interdependence

We now complicate the model by assuming the existence of some complementarities in the production of services and information through the screening activity. First, the larger is the range of services sold by the bank, the lower is the marginal cost of producing information. This is because by selling services the bank acquires some information on the borrower’s type. In particular we are assuming that it is less costly to produce information when services are also produced so that: $C = C(e,S)$ with $\partial C/\partial S < 0$ and $\partial^2 C/\partial e \partial S < 0$. Banks, by selling services, acquire some information on the characteristics of the borrowers.
that they can use to improve the efficiency of the screening activity. This is a first source of complementarity between screening and cross-selling activities. A second source of complementarity derives from the impact that information collected through the screening activity can have on the probability of selling a service other than a loan. In particular, we assume that 

\[ p_s = p_s(e, S) \]

with 

\[ \frac{\partial p_s}{\partial e} > 0 \]

and 

\[ \frac{\partial^2 p_s}{\partial e^2} < 0. \]

Moreover we assume that selling probabilities depend also on the level of the cross-selling activity, with 

\[ \frac{\partial^2 p_s}{\partial e \partial S} > 0, \]

\[ \frac{\partial^2 p_s}{\partial e \partial S} < 0 \]

and 

\[ \frac{\partial^2 p_s}{\partial e \partial S} = 0. \]

We may presume that, if there are relevant information synergies between the provision of loans and that of other services (i.e. information about the services bought by a customer, such as insurance or payment services, may lower banks’ screening costs), there may also be relevant information synergies between the provision of the different services other than loans provided by the bank.

The interdependence between screening costs and cross-selling activities may be very important in order to increase bank efficiency. We shall see that if banks are able to create information synergies between the screening and the cross-selling activities, cross-selling is less likely to reduce the optimal screening effort.

In the case of interdependence between cross-selling and screening activity expected profits are given by:

\[
\pi^* = \left[ \frac{1}{n} - \frac{p_n}{\gamma}(r_i - r_0) \right] [B(e)r + A(e)(v_s p_s(e, S) - r_f - C(e, S)) - K(S)] \quad (5)
\]

**Proposition 3** The optimal level of the screening effort \( e^* \) in the symmetric equilibrium satisfies:

\[
\frac{1}{n} \left[ \alpha'(e^*) \theta_l + \beta'(e^*)(1 - \theta) \eta_l + \left( \frac{\partial p_s(e^*, S)}{\partial e} \right) A(e^*) v_s S - \frac{\partial C(e^*, S)}{\partial e} \right] = 0 \quad (6)
\]

The impact of selling services on the optimal level of the screening effort is obtained by totally differentiating with respect to services equation (6) at the optimal lending rate:

\[
\frac{de^*}{dS} = \left\{ \frac{\frac{\partial^2}{\partial n^2}}{n} \right\} \left\{ \text{num}[1 + (\partial p_s/\partial S)(S/p_s)] + B(e^*) A(e^*) v_s (\partial p_s/\partial e) \right\} + \frac{|J|}{|J|} - \left\{ \frac{\partial^2}{\partial n^2} \right\} \left\{ B(e^*) (\partial^2 C/\partial e \partial S) - B'(e^*) (\partial C/\partial S) \right\} \quad (7)
\]

where \( \text{num} \) is the numerator in (4) and \( |J| \) is the determinant of the Hessian matrix of the system of equations that implicitly define the optimal screening effect and the optimal interest rate that is positive for the second order conditions.

**Corollary 4** In the case of interdependence, the impact of cross-selling on the optimal screening effort is positive whenever:

\[
A(e^*) v_s (\partial p_s/\partial e) - B(e^*) (\partial^2 C/\partial e \partial S) - B'(e^*) (\partial C/\partial S) > -\text{num}[1 + (\partial p_s/\partial S)(S/p_s)]
\]
This is more likely to happen the higher is the impact of screening on the probability of selling services, the higher is the negative impact of services on the marginal cost of screening and the lower is the elasticity of the probability of selling services to the number of services. Finally the negative impact of services on the cost of screening makes it more (less) likely to have a positive impact of cross-selling on screening when $B'(e^*)$ is positive (negative). In general, while in the absence of synergies between the cross-selling and the screening activities cross-selling always reduces screening, when the bank is able to exploit information synergies it becomes less probable that an increase in services induces the bank to decrease its screening effort.

**Corollary 5** When there are enough synergies between the screening and the cross-selling activities so that the impact of services on the optimal screening effort is positive, credit availability increases in good periods and decreases in bad periods.

Information synergies allow to overcome the negative impact of cross-selling on screening incentives and therefore the risk to increase credit availability in bad periods.

### 4 The impact of competition in the lending market on the profitability of cross-selling

Capital market liberalisation in Europe has led to an increase in competition in the lending market. What are the consequences of this trend on banks’ screening activity? And is cross-selling partly a response to increased competition in the lending market?

For answering these questions we now allow for the number of banks to be endogenous (i.e. we look at the long run solution of the monopolistic competition model) and we then investigate the impact of competition (modelled as a decrease in transportation costs) on the profitability of services.

By substituting into expected profits the optimal level of screening and the optimal interest rate and by equating profits to zero we obtain the equilibrium number of firms:

$$n^* = \left( \frac{\gamma B(e^*)}{pK(S)} \right)^{\frac{1}{2}} (8)$$

We can then obtain the optimal level of the interest rate in the long run by substituting (8) in (3):

**Proposition 4** The optimal level of the interest rate in the long run, $r_L^*$, satisfies:

$$r_L^* = \frac{\gamma}{p} \left( \frac{pK(S)}{\gamma B(e^*)} \right)^{\frac{1}{4}} + \frac{A(e^*)}{B(e^*)} (r_f - v_s p_s S) + \frac{C(e^*)}{B(e^*)} (9)$$
We can now look at the impact of increasing competition in the lending market (a decrease in the parameter $\gamma$) on the profitability of services.

The expected profitability of services in the symmetric equilibrium is given by:

$$\pi_S = \frac{1}{n[e^*(r^*(\gamma)), \gamma]} A[e^*(r^*(\gamma))] v_s p_s S - K(S) \quad (10)$$

where the number of banks is given by (8). Equation (10) shows that the profitability of services increases with the selection ratio and the expected revenue from services and decreases with the number of banks and with the cost of services. An increase in competition in the lending market affects the expected profitability of services via several channels. First, it has a direct impact on the equilibrium number of firms; second, by affecting the long run interest rate, it affects the long run optimal screening effort and the selection ratio; third, by affecting the equilibrium screening ratio it affects again the equilibrium number of firms. In order to compute the overall impact of competition on the expected profitability of services we totally differentiate equation (10) with respect to transportation costs, thus obtaining:

$$\frac{d\pi_S}{d\gamma} = -\frac{1}{n^2} A(e^*) v_s p_s S \frac{dn}{d\gamma} + \frac{1}{n} A'(e^*) v_s p_s S \frac{de^*}{d\gamma} \quad (11)$$

where:

$$\frac{dn}{d\gamma} = \frac{1}{2 \gamma} + \frac{n B'(e^*)}{2 B(e^*)} \frac{de^*}{d\gamma} \quad (12)$$

Substituting (12) into (11) we get:

$$\frac{d\pi_S}{d\gamma} = -\frac{1}{n} A(e^*) v_s p_s S \left[ \frac{1}{2 \gamma} + \frac{B'(e^*)}{2 B(e^*)} \frac{de^*}{d\gamma} \right] + \frac{1}{n} A'(e^*) v_s p_s S \frac{de^*}{d\gamma} \quad (13)$$

The impact of competition on the optimal screening effort can be obtained by applying Cramer’s rule to the system of equations that implicitly define the optimal screening effort and the optimal interest rate in the long run, thus obtaining (see Appendix B):

$$\frac{de^*}{d\gamma} = \frac{B'(e^*) B(e^*)}{-2 \rho [\alpha''(e^*) \theta \eta_1 + \beta''(e^*) (1 - \theta) \eta_1 - C''(e^*)] B(e^*) - \gamma B'(e^*)^2} \quad (14)$$

Substituting (14) into (13) and denoting the denominator of (14) with $D$ we have:

$$\frac{d\pi_S}{d\gamma} = -\frac{1}{2 \gamma n} A(e^*) v_s p_s S - \frac{B'(e^*)^2 A(e^*) v_s p_s S}{2 n D} + \frac{A'(e^*) B'(e^*) B(e^*) v_s p_s S}{n D} \quad (15)$$
Multiplying each term of (15) by $D$ and rearranging we have:

$$\frac{d\pi_S}{d\gamma} < 0 \Leftrightarrow -\frac{p}{\gamma} A(e^*)F'(e^*) - \frac{1}{n} A'(e^*)B'(e^*) > 0 \quad (16)$$

**Corollary 6** Whenever $B'(e^*)$ and $A'(e^*)$ have opposite signs or $B'(e^*) > 0$ an increase in competition in the lending market (a decrease in transportation costs) increases the profitability of services. If $B'(e^*) < 0$ and $A'(e^*) < 0$ an increase in competition decreases the profitability of services for high levels of transportation costs but, as transportation costs continue to decrease, the profitability of services eventually rises.

**Proof.** The first term in equation (16) is positive while the sign of the second part depends on the product between $A'(e^*)$ and $B'(e^*)$ and it is also positive when the two terms have opposite signs. Otherwise we can observe that condition (16) requires $\gamma < \frac{npA(e^*)|F'(e^*)|}{B'(e^*)A'(e^*)}$ that is similar to the second order conditions: $\gamma < \frac{npA(e^*)|F'(e^*)|}{B'(e^*)A'(e^*)}$. When $B'(e^*) > 0$ if the second order conditions are satisfied also (16) is satisfied$^1$ and, therefore, competition always increases the profitability of services. We are therefore left with only one case in which competition can lower the profitability of services, i.e. the case in which $B'(e) < 0$ and $A'(e) < 0$. In this case there is a range of transportation costs for which a decrease in transportation costs (an increase in competition) leads to a decrease in the expected profitability of services, but as transportation costs continue to fall, the expected profitability of services will eventually increase also in this case.

The intuition for this result is the following: the impact of competition on the expected profitability of services can be decomposed into: (a) the direct impact of transportation costs on the number of firms for a given level of effort: $-\frac{1}{2\gamma^2} A(e^*)v_s p_s S$; (b) the indirect impact of transportation costs on the number of firms via the impact on the optimal screening effort $\frac{A(e^*)v_s p_s SB'(e^*)}{2n B'(e^*)} \frac{de^*}{d\gamma}$; (c) the impact of transportation costs on the selection ratio via their impact on the optimal screening effort $\frac{1}{n} A'(e^*)v_s p_s S \frac{de^*}{d\gamma}$

The total impact of an increase in transportation costs (an decrease in competition) on the expected profitability of services via the equilibrium number of firms is negative (both (a) and (b) are negative). In particular the direct impact of an increase in transportation costs on the equilibrium number of firms is positive because it leads to a higher interest rate and more entry. The indirect impact is also positive, in fact the sign of the impact of the screening effort on the equilibrium number of firms depends on the sign of $B'(e^*)$ and so does the sign of the impact of transportation costs on the optimal screening effort: when $B'(e^*) > 0$ an increase in transportation costs leads to an increase in the optimal screening effort and this leads to an increase in the equilibrium number

$^1$In fact $\frac{npA(e^*)|F'(e^*)|}{B'(e^*)A'(e^*)} - \frac{npB'(e^*)|F'(e^*)|}{B'(e^*)A'(e^*)} = \frac{npF'(e^*)}{B'(e^*)A'(e^*)} \left[ A(e^*) - \frac{B(e^*)}{A(e^*)} \right]$. When $A'(e^*)$ and $B'(e^*)$ have the same sign the expression in square brackets is positive therefore (16) is always satisfied under the second order conditions when $B'(e^*) > 0$. 

13
of firms, while when \( B'(e^*) < 0 \) an increase in transportation costs leads to a
decrease in the optimal screening effort and this leads again to an increase in
the equilibrium number of firms. The impact of transportation costs on the
profitability of services through the selection ratio depends on the sign of the
product \( A'(e^*)B'(e^*) \). The increase in transportation costs leads to an increase
in the long run interest rate and, when \( B'(e) \) and \( A'(e) \) have opposite signs,
this leads to a decrease in the selection ratio and therefore in the expected
profitability of services. When the two terms have the same sign the overall
impact of competition on the expected profitability of services depends on the
relative magnitude of the impact on the number of firms and on the impact on
the selection ratio but, under a threshold of transportation costs, the impact on
the number of firms prevails leading to a positive impact of competition on the
expected profitability of services.

These results suggest that with a decrease in transportation costs (due, for
example, to the ICT revolution) banks might have experienced a decrease in
profits from the lending activity because of lower interest rates and might have
responded through a process of concentration resulting in a smaller number
of banks of larger size offering a larger set of activities different from loans.
The results of this model are consistent with the view that the transition to a
marketing orientation in banking documented in the literature are, at least in
part, a response to increasing competition in the lending market.

5 Empirical implications and further considerations

Many empirical predictions of our model depend on the degree of synergies be-
tween the banks’ cross-selling and screening activities. In what follows we will
discuss some empirical aspects of our model and propose a tentative classi-
cation of banks’ services based on the interdependence between the screening and
the cross-selling activity.

The impact of cross-selling on screening with no synergies

The model predicts that when there are no synergies between the screening
and cross-selling activities, the increase in services leads to a decrease in the
screening effort. We would therefore expect that small local banks, having
a better knowledge of their customers and a smaller range of services to sell
when compared to large banks, should be more likely to engage in information
intensive lending. This result is consistent with several empirical studies (see

Competition in the lending market and cross-selling

The model predicts that for low levels of competition in the lending market
the expected profitability of services increases. This prediction is consistent with
all the evidence cited in the Introduction showing that banks have responded
to increasing competition in the lending market by partly shifting from more
traditional lending activities to other services. In the US, while at the beginning of the Nineties spread income accounted for about 80% of bank earnings, at the end of the Nineties most of large banks earn more than half of their income from fees and trading income (Allen and Santomero, 2001). In Italy in June 2000 the Italian Banking Association (ABI, Associazione Bancaria Italiana) reported that in 1999 for the first time revenues from services, dividends and other proceeds exceeded returns deriving from traditional activity for 91 among the first 130 Italian banks.

**Synergies between the cross-selling and the screening activities**

In our model the impact of cross-selling on the optimal screening effort and, therefore, on the quality of the pool of financed projects depends on the existence of some synergies between the cross-selling and the screening activities. In the absence of these synergies cross-selling leads to a lower screening effort thus raising some concern on the tradition role of banks as providers of information about borrowers. However the model has shown that if banks are able to fully exploit the potential synergies between the cross-selling and the screening activity, they can have access to other sources of information with positive consequences on the screening effort and on the quality of the pool of financed projects. It is therefore crucial to identify those areas where such synergies can be more easily exploited. In fact we think that the exploitation of information complementarities is crucial for the banking sector since it allows banks to face competition, maintaining, at the same time, their traditional role of producers of information about borrowers. Table 2 reports a tentative classification of services on the basis of the extent of potential synergies between the screening and cross-selling activities captured by the two parameters $\partial p_s/\partial e$ and $\partial^2 C_e(e, S)/\partial e \partial S$, i.e. the impact of screening on the probability of selling a service and the size of economies of scope between the production of information and services.

Table 2 A tentative classification of services

<table>
<thead>
<tr>
<th>$\partial p_s/\partial e$</th>
<th>$\partial^2 C_e(e, S)/\partial e \partial S$</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Customer-specific highly-informative services</td>
</tr>
<tr>
<td>Low</td>
<td>Highly-informative not customer-specific services</td>
</tr>
</tbody>
</table>

In the first row we find those services for which the screening activity is supposed to be important. The collection of information by the bank can increase the probability of selling those services that are customer-specific, i.e. are bought by customers on the basis of their personal characteristics: for example
the bank, by increasing the screening effort (i.e. by carefully studying an investment project), can acquire some information on the propensity to risk of the borrower that can be useful for inducing the customer to sign some insurance contracts. To a lesser extent this information can also be used by the bank for selling to the customer mutual funds with the “right” risk characteristics.

In the first column we find services that are highly informative, in the sense that they provide the bank with some information that can be useful for the screening activity: selling those services to a customer can lower screening costs and increase screening efficiency. This can be the case, for example, of deposits that are characterised by a low degree of customer specificity (second row, first column) but can provide precious information on the amount of resources available to the borrower.

Some services are at the same time customer specific and highly informative (first row and first column). This is the case of insurance: not only the service is customer-specific so that information acquired through the screening activity can enhance the probability of selling the insurance, but it is also informative. The fact that the borrower has signed some types of insurance contracts can provide the bank with valuable information on the risk of the project financed, thus lowering the cost of screening. Insurance is, therefore, a category of services with potentially important synergies with the lending activity of banks. This is consistent with the trend of banks entering the insurance market.

It is also important to observe that the degree of interdependence between the screening and the cross-selling activities depends, not only on the characteristics of the service, but also on the ability of the bank to use efficiently the information collected. The same service, e.g. insurance, can be offered together with loans by a bank in a simple cross-selling activity, with no exchange of information between loans and insurance services, or as a fully integrated product where the bank makes extensive use of information about the customer. In our model the two modalities have very different implications on the impact of cross-selling on the screening activity. The model presented in section 2 has shown that, at least for some types of services, the cross-selling activity can reinforce the banks’ screening effort. However the exploitation of these synergies will depend on the capability of banks to efficiently use the information collected through the screening and the cross-selling activities.

The empirical evidence on the exploitation of information synergies in banks and on its consequences on the quality of the pool of financed projects is very limited. Mester, Nakamura and Renault (2002) report evidence for a Canadian bank that checking account information lowers screening costs, also if they recognise that synergies can be exploited only when the borrower has an exclusive relationship with the bank. This result is consistent with the finding that firms that engage in multiple banking relationships have higher default rates than firms with single banking relationships (Foglia, Laviola and Marullo-Reedtz, 1998; Ferri and Messori, 2000; Harhoff and Körling, 1998; Farinha and Santos, 2002).

According to Frei, Harker and Hunter (1998) it may be difficult for banks to exploit information synergies since banks collect and process information
by product and transaction and not by customer. Van den Berghe, Verweire and Carchon (1999), studying banks cross-selling activities, find that the use of fully integrated services with a high degree of exchange of information between different financial services is more the exception than the rule. Moreover the evidence that small local banks (that typically have a smaller range of services to sell) are more likely to engage in information intensive lending than large banks (see for example Berlin and Mester, 1998 and Cole, Goldberg and White, 1999) is indirect evidence that information synergies have not been exploited in a significant measure by banks.

The empirical evidence, although very limited, raises some concern on the impact of cross-selling on banks’ screening effort. However the existence of potential synergies between the screening and the cross-selling activities, at least in some specific services areas, suggests that there is scope for banks to maintain their role of producers of information about borrowers, although this requires a different way to collect and process information.

6 Conclusions

This paper has examined the impact of cross-selling on the banks’ optimal screening effort. We have found that, when there is no interdependence between the cross-selling and the screening activity, cross-selling reduces the optimal screening effort. In our model cross-selling may have the same implication for the screening activity of collateral in the model of lazy banks proposed by Manove, Padilla and Pagano (2001). These results can cause some concern since they imply that the more the banking system evolves towards non traditional activities, the less will be its screening effort, with a negative influence on the quality of the pool of investment projects financed. However the existence of some elements of interdependence between the cross-selling and the screening activities makes the trade-off between cross-selling and screening less likely.

Cross-selling may even increase the screening effort if banks use efficiently the information from the cross-selling activity for screening loan projects and if they use efficiently the information collected during the screening process for the cross-selling activity. The possibility of exploiting the complementarities depends not only on the bank’s ability but also on the type of services that the bank tries to sell. We have proposed a tentative classification of services according to their degree of customer-specificity and information-intensity since we think that these two elements are useful for analysing the interdependence between cross-selling and screening. Future studies, focussing on this issue, could provide a more comprehensive classification of services that can help to clarify their relationship with the more traditional banking activities. Moreover the existence of such complementarities can be investigated by future empirical analyses.

Finally the model proposed in this study suggests that competition in the lending market can be one of the explanations for the transition of banks towards non traditional activities. In fact we have shown that for sufficiently low levels of
transportation costs an increase in competition in the lending market increases the profitability of services.

An interesting implication of the model presented in this paper is that cross-selling can give rise to multiple banking relationships. If a bank follows a transaction oriented strategy and the demand for loanable funds is higher than the amount of loanable funds, it is optimal for the bank to grant loans of smaller size to all loan applicants rather than fully financing only a part of them, in order not to lose part of services’ revenues. This suggests that the puzzle of multiple banking relationships perhaps may be solved looking at the bank’s behaviour rather than looking at the borrower’s behaviour and that the cross-selling strategy may be a possible answer to the question of why a profit maximising bank may choose not to fully finance a positively evaluated borrower. Further analyses could explore, both theoretically and empirically, the relationship between cross-selling and multiple banking relationships.
Appendix A

The implicit equations that define the optimal screening ratio and the optimal interest rate in the symmetric equilibrium are:

\[ F_e = \frac{1}{n} [A'(e^*)(p_s v_s S - r_f) + B'(e^*)r^* - C'(e^*)] = 0 \quad (A1) \]

\[ F_r = -\frac{p}{\gamma} B(e^*)r + \frac{1}{n} B(e^*) - \frac{p}{\gamma} [A(e^*) (p_s v_s S - r_f) - C(e^*)] = 0 \quad (A2) \]

the Jacobian of the system with respect to the endogenous variables is:

\[ |J| = \begin{vmatrix} \frac{1}{n} [A''(e^*) (p_s v_s S - r_f) + B''(e^*)r^* - C''(e^*)] & \frac{1}{n} B'(e^*) \\ \frac{1}{n} B'(e^*) & -\frac{p}{\gamma} B(e^*) \end{vmatrix} \]

Applying Cramer’s rule we have:

\[ \frac{de^*}{dS} = \frac{\begin{vmatrix} -\frac{1}{n} A'(e^*) p_s v_s & \frac{1}{n} B'(e^*) \\ \frac{p}{\gamma} A(e^*) p_s v_s & -\frac{p}{\gamma} B(e^*) \end{vmatrix}}{|J|} \]

which gives equation (4).

Note that \( |J| \) is also the determinant of the Hessian matrix

\( \begin{vmatrix} \frac{\partial F_e}{\partial e} & \frac{\partial F_r}{\partial e} \\ \frac{\partial F_e}{\partial r} & \frac{\partial F_r}{\partial r} \end{vmatrix} \)

therefore the second order conditions for the optimal screening effort and interest rate require:

\[ \frac{1}{n} [A''(e^*) (p_s v_s S - r_f) + B''(e^*)r^* - C''(e^*)] < 0 \quad (A3) \]

\[ -\frac{B(e^*) p}{\gamma n} [A''(e^*) (p_s v_s S - r_f) + B''(e^*)r^* - C''(e^*)] - \frac{B'(e^*)^2}{n^2} > 0 \quad (A4) \]

Condition (A3) is always satisfied under our technology assumptions (note that it can be rewritten as \( \alpha''(e^*) \delta \eta_h + \beta''(e^*) \delta \eta_l - C''(e^*) \) with \( \alpha''(e) < 0 \), \( \beta''(e) > 0 \), \( C''(e) > 0 \), \( \eta_h > 0 \) and \( \eta_l < 0 \) (in fact we have assumed \( z p_l + p_s v_s S - r_f < 0 \)).

Condition (A4) holds under some parameter restrictions. In particular substituting in (A4) for the symmetric equilibrium interest rate and rearranging we find that condition (A4) is satisfied for:

\[ \gamma < \frac{[A''(e^*) B(e^*) - B''(e^*) A(e^*)][r_f - v_s p_s S] - B''(e^*) C(e^*) + C''(e^*) B(e^*)}{B'(e^*)^2 + B''(e^*) B(e^*)} \quad np \quad (A5) \]
or:

$$
\gamma < \frac{\theta(1 - \theta)(p_h - p_l)[\beta''(e^*) \alpha(e^*) - \alpha''(e^*) \beta(e^*)][r_f - p_s S] - B''(e^*)C(e^*) + C''(e^*)B(e^*)}{B'(e^*)^2 + B''(e^*)B(e^*) \eta p}
$$
Appendix B

The implicit equations that define the optimal screening ratio and the optimal interest rate in the symmetric equilibrium with endogenous $n$ are:

\[ F_e = \left( \frac{pK(S)}{\gamma B(e^*)} \right)^{\frac{1}{2}} \left[ A'(e^*)(p_s v_s S - r_f) + B'(e^*)r^* - C'(e^*) \right] = 0 \quad (B1) \]

\[ F_r = -\frac{p}{\gamma} B(e^*)r + \left( \frac{pK(S)}{\gamma B(e^*)} \right)^{\frac{1}{2}} B(e^*) - \frac{p}{\gamma} \left[ A(e^*)(p_s v_s S - r_f) - C(e^*) \right] = 0 \quad (B2) \]

the Jacobian of the system with respect to the endogenous variables is:

\[
|J| = \begin{vmatrix}
\frac{1}{n} \left[ A'(e^*)(p_s v_s S - r_f) + B'(e^*)r^* - C'(e^*) \right] & \frac{1}{n} B'(e^*) \\
\frac{1}{2n} B'(e^*) & -\frac{p}{\gamma} B(e^*)
\end{vmatrix}
\]

Applying Cramer’s rule we have:

\[
\frac{de^*}{d\gamma} = \frac{1}{|J|} \begin{vmatrix} 0 & \frac{1}{n} B'(e^*) \\ -\frac{B(e^*)}{2\gamma n} & -\frac{p}{\gamma} B(e^*) \end{vmatrix}
\]

which gives equation (14).
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